

Claims

[c1] A method for dense encoding and retrieving of information represented in electronic computers, the method comprising

- (a) choosing an appropriate modulus m , positive integer n , corresponding to the number of bits to be encoding, and generating $n \times n$ matrix A with integer elements where the diagonal elements of A differs modulo m from all the other elements of their column, and where A can be written as matrix product BC where B is an $n \times t$ matrix, C is a $t \times n$ matrix, where t is less than n ;
- (b) encoding the length- n vector x to the length- t vector xB , by vector-matrix product modulo m ;
- (c) storing the length- t vector xB in physical computational devices;
- (d) retrieving the stored vector by computing $xBC = xA$ by vector-matrix product modulo m ;
- (e) for every coordinate of vector $xBC = xA$, filtering out the terms added as the linear combination of other coordinates of vector x .

[c2] A method according to claim 1, wherein the modulus m is non-prime- power composite positive integer, the diagonal elements of matrix A are non-zero modulo any prime-divisors of m , and each non-diagonal elements of matrix A are zero modulo for at least one prime divisor of m .

- [c3] A method according to claim 2, wherein the filtering step for retrieving the original values of the encoded 0-1 vector x further comprising:
- (a) periodical change of the values of the coordinates of vector x with original value equal to 1 on values $0, 1, 2, \dots, m-1$, and no change of the values of the coordinates of vector x with original value equal to 0;
 - (b) measuring the periodicity of each coordinates of vector x BC= x A;
 - (c) if a coordinate has period equal to m then its original value was 1.
- [c4] A method according to claim 1, wherein vector x to be compacted is a row-vector of a matrix.
- [c5] A method according to claim 1, wherein vector x to be compacted is a column-vector of a matrix.
- [c6] A system for dense encoding and retrieving of information represented in electronic computers or other physical devices, the system comprising
- (a) choosing a modulus m to be a non-prime-power composite positive integer, positive integer n corresponding to the number of bits to be encoded, and generating $n \times n$ matrix A with the diagonal elements being non-zero modulo any prime-divisors of m , and each non-diagonal elements of matrix A are zero modulo for at least one prime divisor of m , and where A

can be written as matrix product BC where B is an $n \times t$ matrix, C is a $t \times n$ matrix, where t is less than n ;

(b) choosing step-functions s_1, s_2, \dots, s_n on the $[a, b]$ real interval, corresponding to time, such that the following properties hold:

(b1) function s_i has finitely many, but at least one non-zero steps modulo m , for $i=1, 2, \dots, n$;

(b2) step of function s_i is either 0 modulo m or it is non-zero modulo all individual prime-divisors of number m , for $i=1, 2, \dots, n$;

(b3) no two different functions s_i and s_k have non-zero steps in the same point r in the real interval $[a, b]$;

(c) by denoting the n bits to be stored by h_1, h_2, \dots, h_n , bit h_i is encoded first as $x_i = h_i s_i$, for $i = 1, 2, \dots, n$;

(d) with matrix B , $z = xB$ is computed;

(e) step functions z_1, z_2, \dots, z_t are stored;

(f) $x' = zC = xBC$ modulo m is computed;

(g) by observing the change of the values of the piecewise constant function x'_i , we conclude that if all the steps of function x'_i are 0 modulo at least one prime divisor of m , then $h_i = 0$, otherwise, $h_i = 1$.

[c7] A system, according to claim 6, wherein step-functions are stored in physical devices admitting linear combinations, and the values of the steps modulo m can be observed from the spectrum of electromagnetic radiation emitted by the devices.

[c8] A system according to claim 6, wherein vector $h=h_1, h_2, \dots, h_n$ to be compacted is a row-vector of a matrix.

[c9] A system according to claim 6, wherein vector $h=h_1, h_2, \dots, h_n$ to be compacted is a column-vector of a matrix.

[c10] A method for computing the product of the $n \times n$ matrix X and the $n \times n$ matrix Y , the method comprising:

- (a) the column compacting of matrix X is done by computing $B^T X$;
- (b) the row compacting of matrix Y is done by computing YB ;
- (c) from the $t \times n$ matrix $B^T X = \{u_{ij}\}$ and from the $n \times t$ matrix $YB = \{v_{kl}\}$ the $t \times t$ matrix $W = \{w_{il}\}$ is computed as:
$$w_{il} = \sum_{j=1}^t \left(\sum_{k=1}^n b_{kj} u_{ik} \right) \left(\sum_{k=1}^n c_{jk} v_{kl} \right);$$
- (d) the column expanding process is done by computing $C^T W$;
- (e) the row expanding process is done by computing $C^T W C$;
- (f) a filtering process is done for retrieving the values of the product matrix.